Multifarious utilization of shrimp waste at Visakhapatnam

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Shrimp with 16% of the total value of internationally traded fishery products (Food and Agriculture Organization, 2009) constitute the major marine resource traded in terms of value. Frozen fish and frozen shrimp are the important marine export items. About 85 species of shrimp are known to exist in Indian waters of which 55 species are reported either as commercially important or having considerable demand in the local as well as international markets.

The recovery of biochemical compounds from seafood waste materials, which could be used in different ways, is a promising area of research for development of methods for utilization of seafood by-products. The solid shrimp waste *viz.*, head and shell accounts approximately 40-50% of whole shrimp weight. These wastes contain protein (35-40%), chitin (10-15%), minerals (10–15%) and caroteinoids (Sachindra and Bhaskara, 2008). In India, Central Institute of Fisheries Technology (ICAR), has initiated research on chitin and chitosan. They found that dry prawn waste contained 23% and dry squilla contain 15% chitin (Madhavan and Nair, 1974). They also reported that chitinous solid waste fraction of the average annual landing of shellfish ranges from 60,000 to 80,000 tonnes. The price of chitosan, a cationic polysaccharide is $ 7.5 for 10 g.

The annual landings of both penaeid and non-penaeid prawns at Visakhapatnam ranged from 7797 t to 10636 t during 2008 - 2012 period with an annual average landing of 9717 t (Fig.1). Random samples of both high and low value shrimps were collected to estimate the amount of wastes generated. The head generally constitutes 38 to 40% in both the

Fig. 1. Visakhapatnam Fishing Harbour

types and the shell constitutes 11to 14%. In low value prawns the weight of the shell is 2 to 4%. These shrimp wastes constitute about 53% of the total waste. During the period 2008-2012 the total shrimp wastes generated ranged from 4132 t to 5637 t with an average 5150 t annually (Fig. 1).

Shrimp waste is usually dried on the beaches that results not only in environmental pollution but also reduces the recoverable components (Fig. 2). A better economic use of the shrimp head would

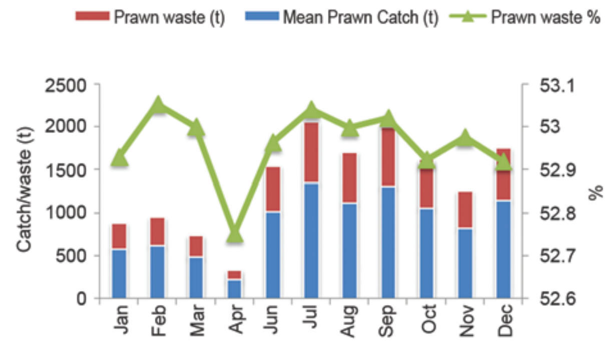

Fig. 2. Mean monthly variation in prawn catch and waste generated during 2008-2012 at Visakhapatnam

Fig. 3. Headless shrimps for transport and trade

Fig. 4. Drying of shrimp wastes at Visakhapatnam Fishing Harbour

minimize the pollution problem and at the same time maximize the profits of the processor. Shrimp heads and the smaller legs of crabs can be collected from the landing centres and fish markets, cleaned and supplied to small restaurants, hotels and added to the common Indian recipes. Shellfish head waste can be used in production of soups, stocks and sauces for retail sale. Utilization of fermented fish/ shellfish sauces in ancient times was common in Rome and is now extremely popular in many Asian countries where they form a staple part of the diet. Autoclave treatment of shellfish waste can be done where steam is applied under pressure for a specific period of time. This produces a clean sterile material with flesh, shell and an organic liquid. The sterile shell can be separated from the liquid, sorted and treated for use in a wide range of secondary products. With further treatment the liquid can be used to produce fertilizer, or it can be anaerobically digested to produce methane for use as biofuel.

The fleshy wastes from shellfish are suitable material for baits. Fishermen at Lawsons Bay and other landing centres at Visakhapatnam have to buy the bait at ₹ 200/- per kg which adds to the total fishing cost. Fishing of yellowfin tuna *Thunnus albacares* and other tunas using hooks and line by the traditional fishermen at different landing centres of Visakhapatnam is a regular activity using shrimps as bait. Rohit (2010) reported that the crustaceans were the most abundant prey items for yellowfin tuna. ‘Single species’ baits and ‘Mixed species’ baits with low value shrimps can be tested by the fishermen to reduce the cost of baits. Shrimp wastes can also be used for preparation of compost along with equal amount of cowdung with 10% urea and applied as manure in brackishwater shrimp culture ponds.

The shrimp waste also contains useful components such as protein, lipid and astaxanthin pigment, thus making the commercial shrimp waste an attractive material for extraction of the above-mentioned components (Meyers, 1986). Astaxanthin is a natural nutritional component, an antioxidant and can be used as a food supplement. In India cod liver oil and other fish oil are given as food supplement for providing omega-3 fatty acids which have beneficial effects on cardiovascular health, inflammation, mental health, and neurodegenerative diseases. Recent studies have reported that adding the antioxidant astaxanthin to fish oil reduces its susceptibility to oxidation and makes its immunomodulatory properties more potent. Crustacean exoskeletons contain 15–20% chitin by dry weight. The production of chitin and chitosan from crustacean canning has proved environmentally attractive and economically feasible, especially when it includes the recovery of carotenoids. Shrimp waste is one of the most important natural sources of carotenoids and the head and body carapace can be used for carotenoid extraction with various organic solvents and solvent mixtures under various extraction conditions (Shahidi *et al*., 1998). The recovered carotenoids can be effectively used instead of synthetic carotenoids in aquaculture feed formulations, and the residue available after extraction may be used for the preparation of chitin/chitosan. Conventional processing methods are time consuming and expensive and therefore innovations in the processing methods will reduce time and cost. Chitosan, produced from shrimp and crab shell, has wide range of applications from cosmetic to pharmaceutical industries. Protein and pigments found in shrimp waste are excellent animal feed supplements.

Proteases are the most important group of industrial enzymes used in the world and find several applications. Proteolysis is one of the gentle methods for recovering proteins from shrimp wastes. Rich protein hydrolysates generated with low fat content can be useful for food and feed purpose. The insoluble fractions generated can be further separated and reutilized. The utilization of the shrimp wastes in a proper manner will help to make the industry environment friendly and more efficient.